

U.S. UTILITY PATENT APPLICATION

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MALTWEB MULTI-AXIS VIEWING INTERFACE
AND HIGHER LEVEL SCOPING

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MALTweb Multi-Axis Viewing Interface and Higher Level Scoping

Field of the Invention

The present invention relates generally to an electronic publishing system and, in particular, to aids for navigating in an electronic publishing system and a method of organising data in an electronic publishing system.

Background

International Publication No. WO 98/34179 (PCT/AU98/00050), corresponding to US Patent Application No. 09/108999, is incorporated herein by cross reference and discloses an electronic publishing system that provides a sparse multidimensional matrix of data using a set of flat file records. In particular, the computer-implemented system publishes an electronic publication using text-based data. Predefined portions of the text-based data are stored and used for the publication. At least one of the predefined portions is modified, and the modified version is stored as well. The predefined portion is typically a block of text, greater in size than a single word, but less than an entire document. Thus, for example, in the case of legislation, the predefined portion may be a section of the Act. Each predefined portion and the modified portion(s) are marked up with one or more links using a markup language, preferably SGML or XML. The system also has attributes, each being a point on an axis of a multidimensional space for organising the predefined portions and the modified portion(s) of the text-based data. This system is simply referred to as the Multi Access Layer Technology or "MALT" system hereinafter.

Existing methods of navigating electronic publications have been derived from traditional methods used to navigate printed publications. Typical of these methods is the use of a bookmark, which is merely an indicator which identifies a page or section of

interest. Bookmarks are typically limited in the information provided to users. Bookmarks follow a single axis, perhaps indicating the current page, chapter and title of the publication. However, bookmarks do not necessarily provide the user with adequate context pertaining to how the user arrived at the current page. If a user knows the exact publication desired and then navigates through the same publication, a bookmark is probably adequate for the user's needs. In the event that the user has conducted a number of searches and trawled through various versions of different documents to arrive at the current page of a publication, it is impossible for a bookmark to capture all the relevant information and provide the user with an adequate reading context. The book metaphor fails to address the abilities and complexities of electronic publications.

Existing methods of navigating compact disc based publications and Internet sites are typically ill-suited to displaying the complex data provided by MALT. Known web solutions, for example, typically handle two axes, sequential and hierarchical, using either embedded links such as Previous, Next and Contents, or expandable content frames, as provided in Windows Explorer. Further axes may be handled by incorporating embedded links in the body of the text. Such embedded links are point to point, and provide limited navigational value to the user.

Object databases are capable of providing the required functionality, but search queries employed by these databases are too complicated for untrained users, both in terms of the complexity and amount of information required.

Thus, a need clearly exists for a detailed context to be provided to users of electronic publishing, overcoming one or more disadvantages of existing systems.

Summary

According to a first aspect of the invention, there is provided a method of navigating in a multidimensional space containing an electronic publication formed from

predefined portions of text-based data encoded using a markup language. The method includes the steps of:

- displaying a selected one of the predefined portions in a first display region; and
 - displaying a point on a selected axis of the multidimensional space for the
- 5 displayed predefined portion.

According to a second aspect of the invention, there is provided a method of navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language. The method includes the steps of:

- 10 providing a view comprising at least two anchor sets;
- displaying at least one base point and at least a first axis depending from the base point;
- displaying at least one of a further point and an axis derived from the base point;
- navigating a multidimensional space formed by the points and axes;
- 15 returning to the base point when required; and
- adjusting the view so a current view point becomes a new base point.

- According to a third aspect of the invention, there is provided an apparatus for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language. The apparatus
- 20 includes:

- a device for displaying a selected one of the predefined portions in a first display region; and

- a device for displaying a point on a selected axis of the multidimensional space for the displayed predefined portion.

According to a fourth aspect of the invention, there is provided an apparatus for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language. The apparatus includes:

- 5 a device for providing a view comprising at least two anchor sets;
- a device for displaying at least one base point and at least a first axis depending from said base point;
- a device for displaying at least one of a further point and an axis derived from the base point;
- 10 a device for navigating a multidimensional space formed by the points and axes;
- a device for returning to the base point when required; and
- a device for adjusting the view so a current view point becomes a new base point.

- According to a fifth aspect of the invention, there is provided a computer
- 15 program product having a computer readable medium having a computer program recorded therein for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language. The computer program product includes:

- a computer program code module for displaying a selected one of the predefined
- 20 portions in a first display region; and
- a computer program code module for displaying a point on a selected axis of the multidimensional space for the displayed predefined portion.

- According to a sixth aspect of the invention, there is provided a computer
- program product having a computer readable medium having a computer program
 - 25 recorded therein for navigating in a multidimensional space containing an electronic

publication formed from predefined portions of text-based data encoded using a markup language. The computer program product includes:

a computer program code module for providing a view comprising at least two anchor sets;

5 a computer program code module for displaying at least one base point and at least a first axis depending from said base point;

a computer program code module for displaying other points, axes or both derived from said base point;

a computer program code module for navigating a multidimensional space
10 formed by said points and axes;

a computer program code module for returning to said base point when required;
and

a computer program code module for adjusting the view so a current view point becomes a new base point.

15 According to a seventh aspect of the invention, there is provided a method of publishing an electronic publication formed from predefined portions of text-based data encoded using a markup language. The method includes the steps of:

storing predefined portions in terminal nodes; and

providing one or more higher level nodes for organising said terminal nodes to
20 correspond with a hierarchical structure embodied in said electronic publication, wherein each higher level node consists of the identity of a parent node, a position indicator for said higher level node, and an identifier.

According to an eighth aspect of the invention, there is provided an apparatus for publishing an electronic publication formed from predefined portions of text-based data
25 encoded using a markup language. The apparatus includes:

a device for storing predefined portions in terminal nodes; and

a device for providing one or more higher level nodes for organising said terminal nodes to correspond with a hierarchical structure embodied in said electronic publication, wherein each higher level node consists of the identity of a parent node, a position indicator for said higher level node, and an identifier.

According to a ninth aspect of the invention, there is provided a computer program product having a computer readable medium having a computer program recorded therein for publishing an electronic publication formed from predefined portions of text-based data encoded using a markup language. The computer program product includes:

a computer program code module for storing predefined portions in terminal nodes; and

a computer program code module for providing one or more higher level nodes for organising said terminal nodes to correspond with a hierarchical structure embodied in said electronic publication, wherein each higher level node consists of the identity of a parent node, a position indicator for said higher level node, and an identifier.

Other aspects of the invention are also disclosed.

Brief Description of the Drawings

One or more embodiments of the present invention are described hereinafter with reference to the drawings, in which:

Fig. 1 is a screen shot of a Normal axis view of a MALT publication (with a search mode enabled) in accordance with an embodiment of the present invention;

Fig. 2 is a screen shot of a Versions axis view of a MALT publication in accordance with an embodiment of the present invention;

Fig. 3 is a screen shot of a Source axis view of a MALT publication in accordance with an embodiment of the present invention;

Fig. 4 is a block diagram representation of higher level scoping in accordance with an embodiment of the present invention;

5 Figs. 5A, 5B and 5C are screen shots illustrating a commentary in accordance with a further embodiment of the invention; and

Fig. 6 is a computer program product block diagram.

Detailed Description

OVERVIEW

10 A method, apparatus and computer program product for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language are disclosed. In the following description, numerous specific details are set forth. However, it will be apparent to those skilled in the art in view of this disclosure that changes may be made
15 without departing from the scope and spirit of the invention. In other instances, well known features have not been described in detail so as not to obscure the invention. Whilst the invention may be preferably practised on flat files, it will be apparent to a person skilled in the art that the invention may also be practised on databases. A database may be constructed from sets of flat file records. A relational database is a collection of
20 related tables, each table being a set of flat files having the same structure. The method includes the step of: displaying a selected one of the predefined portions in a first display region. The display region preferably takes the form of an area of real estate on a computer screen (henceforth referred to as the "content frame"). The method also includes the step of displaying a view into a primary axis of the multidimensional space in
25 which the displayed preferred portion is clearly marked. This second area of the

computer screen shall be referred to as the "reference frame". Each frame has an associated "anchor", which is a title bar clearly indicating the nature of the view currently displayed in the frame. The reference anchor also contains tools for navigating the displayed axis. The method also includes the step of displaying a point on a primary axis

5 of the multidimensional space for the displayed predefined portion.

The method may be enhanced by displaying a second point on a second axis which relates to the first axis at the first point. The second axis represents time-based versions of the selected one of the predefined portions. Alternatively, the second axis represents amending legislation that was applied to the selected one of the predefined

10 portions. In another example, the second axis represents case law that applied the selected one of the predefined portions. In further example, the second axis represents annotations to the selected one of the predefined portions. In a yet further example, the second axis represents entries of a subject index that are covered in the selected one of the predefined portions.

15 The embodiment of the present invention allows for a primary axis (the combined hierarchical/sequential or normal axis). A "base node" may be selected by navigating the primary axis. The method then allows for one of a number of potential axes (associated with the base node) to be selected and subsequently navigated. The selection is accomplished by means of activating "links" in the displayed base node. The

20 reference frame is redrawn to give a view of the members of the selected axis and one member of that axis is displayed. At any point it is possible to return to the primary axis and select a new base node. Alternatively, the currently displayed base node may be chosen as a new base node from which subsequent axes are derived. In this manner, any number of axes may be displayed and navigated without increasing the complexity of the

screen view (i.e. only two frames are ever required). It is this quality which allows a complex dataset to be navigated by a non-specialist end user.

By way of example, a user may select a first node, corresponding to a provision, in the multidimensional space. The first node's locator is displayed in a first anchor to provide the user with a first point of reference. If the user is interested in different versions of the provision, the user may then move to second node on an orthogonal axis, being the Versions axis. The first anchor is updated and displays the locator of the second node. A second anchor displays the locator of the first node. The second anchor also displays the relationship between the first node and the second node. The user is provided with information which indicates the original provision that was being studied, the provision currently being studied and the current provision's relationship to the original provision. Thus, the first and second anchors and the information provided therein enable the user to navigate the multidimensional space.

Where reference is made in any one or more of the accompanying drawings to steps and/or features, which have the same reference numerals, those steps and/or features have for the purposes of this description the same function(s) or operation(s), unless the contrary intention appears.

The principles of the preferred method described herein have general applicability to electronic publishing. However, for ease of explanation, the steps of the preferred method are described with reference to navigating in a MALT publication. However, it is not intended that the present invention be limited to the described method. It will be appreciated by those skilled in the art that a publication could include a document or a database. The invention may apply to any hierarchical XML data where any of the nodes may change independently of other nodes in the hierarchy. Typical examples might include manuals and newspapers. For example, the invention may have

application to the production and display of aircraft manuals. In this case, each node would be a set of maintenance instructions for a part or assembly. The axes might be part number; category (electrical, structural, etc.); location (Boeing 737, wing, wingtip assembly, eddy baffle, securing flange AX-703); airline (United, QANTAS); language
5 (English, French). Since each commercial aircraft is in effect a one-off construct, the basic information needs to be reconfigured for each plane, each airline, etc.

Before proceeding with a description of the embodiments, a brief review of terminology is discussed hereinafter. A dataset refers to the complete set of data that is to be navigated. A dataset has a complete set of discrete objects called nodes. The dataset
10 may be viewed as a sparse multidimensional matrix, as is produced using the MALT publishing method. In the example of this specification, the dataset preferably refers to a body of legislation designed for point in time searching.

A node preferably corresponds to a particular legislative provision at a particular date. A base node is a particular node from which one or more viewing axes may be
15 derived.

A viewing axis is an ordered set of nodes derived from a single base node. The base node itself may or may not constitute part of the axis. For example, given a particular provision in time, three possible viewing axes are: the set of all provisions in force on the same date as the base node; the set of versions of the base provision in time;
20 and the set of amending provisions most recently applied to the base provision. Further viewing axes may be practised, and may include case law that applied the provision, annotations to the provision and entries of a subject index that are covered in the provision.

A provision, for the purposes of this system, is a unit of legislation having a
25 heading and/or content, but not including text belonging to any sub-provision that is a

predefined portion of text. A provision may be an Act, a schedule, a chapter, a section or other legislative unit. A provision has a scope in time, such that when a provision is amended, a new provision is created. A provision corresponds to a set of nodes, each node corresponding to a range of dates in the scope of the provision.

- 5 Scope refers to a period of time during which a provision is in force. Thus, a given scope is usually expressed as start and end dates. A provision's scope is determined by the dates on which the provision commenced, was amended and/or was repealed.

- A locator is an identifier that is used to locate a particular node. For example, a
10 locator may be a date, or a position such as the name of an Act and a section number.

MULTI-AXIS VIEWING INTERFACE

- Using the publication of legislation as an example, a *provision* is defined as being an amendable unit of legislation. At any given moment, the body of active
15 legislation can be divided into provisions. Provisions also have a scope in time, so that when a provision is amended, the current provision goes out of scope and a new provision is created. The *nodes* of the dataset in this example are provisions with an associated date. Two *locators* are required to specify a particular node uniquely: a position (such as act and section number) and a date.

- 20 There are a number of *viewing axes* associated with each node. As indicated in the explanation of terminology above, a viewing axis is defined as an ordered set of nodes that can be derived from the current node. When XML data is converted to a series of flat files, viewing axes are derived from the current node as a result of an intersection between two flat files. Two flat files intersect if common entries are contained in the
25 fields of the respective flat files. For example, a legislation flat file may contain a field

"Identifiers of cases that apply this provision". The legislation flat file shares a common entry with a case law flat file. Alternatively, the legislation flat file may contain a field "subjects covered in the provision". In this example, the legislation flat file shares a common entry with a subject index flat file. Alternatively, an amending legislation flat
5 file may have a field "Identifiers of provisions amended by this provision" and share a common entry with the legislation flat file.

In a preferred example, seven such viewing axes are:

- Sequential (...; s 26; s 27; s 27A; ...),
- Hierarchical (...; Corporations Act 1989; Part 2; Division 2.1; s 27),
- 10 • Temporal (the set of versions of the current provision in time),
- Source (the set of provisions which amend the current provision),
- Case law (cases that apply the current provision),
- Annotations (annotations to the current provision), and
- 15 • Subject (Entries of a subject index that are covered in the current provision).

The above axes are orthogonal in the sense that none can be directly derived from another. Thus, the temporal axis cannot be derived from the sequential axis. Moreover, members of the temporal axis are not simply those provisions sharing the same locator as the current provision. As a result of renumbering, members of the same temporal axis
20 may possibly have widely differing locations. While the example uses two locators and four viewing axes, the MALTweb interface is capable of handling as many locators and axes as required.

Having utilised MALT to construct a set of data encapsulating the above relationships, the problem is how to access this data in a meaningful way. To provide an

untrained user with full multi-axis access to MALT type data whilst maintaining a consistent look and feel throughout, a view consisting of a two frame screen is provided.

Fig. 1 is a screenshot 100 depicting a section of legislation in accordance with an embodiment of the invention. A content frame 110 displays the content of the current node. In essence, this frame 110 constitutes a known portion of display "real estate". In the example of Fig. 1, the node corresponds to Section 59 of the Commonwealth Corporations Act 1989 and the node has a scope of 16 October 1995 onwards. The scope indicates the time during which the provision is in force. The content anchor 105 of the content frame 110 displays the locators for the current content provision in a user friendly form, such as:

Corporations Act 1989 (Cth): s 59

(Scope: 16 Oct 1995 onwards)

Situated above the content anchor 105 is a reference frame 120, which contains a set of links 121 corresponding to the members of a viewing axis associated with the current base node. Reference markers 123 indicate which of the links 121 is currently selected. In the Normal view, the content node shown in the content frame is always the same as the base node for the reference frame. In the Version view, the content node and base node are initially the same, but deviate when a different version is selected. In the Source view, the base node is being amended and the content node is one of the amending provisions.

The reference frame 120 has a corresponding reference anchor 115, which describes the current viewing axis and provides buttons 116, 118 for navigating the sequential axis and button 117 for accessing higher levels of the hierarchy. These levels can also be accessed via the links 121 in the reference frame. In the example, the reference anchor 115 indicates that the user is being shown a normal view of s59, as in

force on 20 July 2000. This view also shows the search mode, in which the text "exercise of jurisdiction" has been located. The buttons 112, 113 allow access to the next or previous occurrence of this text, whilst button 114 cancels the search. The "hits" links 122 in the reference frame allow rapid access to occurrences of the search text in other parts of the document. In this respect, the search mode acts very much like a separate viewing axis. The highlighting 106 indicates the selected text. Finally, the links 107, 108 allow access to the other viewing axes (in this case, Versions and Amendments).

Where appropriate, the reference anchor 115 may indicate the base node of the viewing axis. The base node is the node from which the viewing axis is derived. For example, the reference anchor 315 of Fig. 3, which shows a Source axis view of the same provision depicted in Fig.1, displays the following information:

**Provisions amending (effective 16 Oct 1995)
Corporations Act 1989 (Cth): s 59**

This indicates that the Source axis being viewed by the user is derived from the base provision : Corporations Act, s59 [16 Oct 1995 onwards]. The content anchor 305 details the amending provision, which in this example is Corporations Legislation Amdt Act 1994 (Cth):Sch 1.

The relationship of the base node and the content node depends on the view. In the Normal axis view, consisting of the sequential and hierarchical axes, the base node and the content node are always the same. In the Versions axis view, the base node and the content node may or may not be the same. A view is, therefore, defined as the display of a particular content node in relation to a specified axis. Each view may be uniquely identified from the following: the current content node, the current viewing axis, and the base node of the viewing axis. To further help the user in distinguishing the different viewing axes, the reference frame links may optionally vary in colour, content and indenting style among the views.

Fig. 2 shows a Version axis view 200 of the provision depicted in Fig. 1. The content anchor 205 indicates that the provision being displayed is, in fact, an earlier version of the provision displayed in Fig. 1. Thus, the information shown in the content frame 210 has a different scope from the information shown in content frame 110 of Fig.

- 5 1. Closer examination of the information of the content frame 210 and the information of content frame 110 indicates that amendments have in fact been made between the two versions of the provision.

The reference frame 220 of Fig. 2 indicates that there are two versions of the provision, a first version with a scope of 1 January 1994 to 15 October 1995 and a second
10 version with a scope of 16 October 1995 to 31 December 2001. Each version of the provision is a distinct node on the Version axis. The reference anchor 215 indicates that the user is navigating along the Versions axis view of section 59.

Fig. 3 shows a Source axis view 300 of the provision under consideration. The reference anchor 315 of Fig. 3 indicates to the user that the material being displayed
15 relates to provisions amending the Corporations Act 1989 (CTH); s 59. The reference frame 320 indicates that there are three relevant nodes 321, 322, 323 on the source axis. Each node corresponds to a provision which amends the current provision. The amending provisions are not necessarily sequential and may be non-consecutive and/or in different schedules and/or in different Acts. The content anchor 305 indicates that the current
20 information being shown is Schedule 1, Part 1, Item 15 of the Corporations Legislation Amendment Act 1994, corresponding to the first node 321 shown in the reference frame 320. The content of the amending act is displayed in the content frame 310.

Thus, the multi-access viewing interface provides a user with content and reference components. Anchors uniquely identify the content node by position and date,
25 and the viewing axis by base node and axis type. Furthermore, the reference frame is

capable of displaying multiple viewing axes for a given base node, as illustrated in Figs. 1-3.

HIGHER LEVEL SCOPING

- 5 The MALT concept encapsulates the ability to store the contents of a sparse multidimensional matrix in a set of flat file records. As previously defined, the scope of a provision is a time period during which the given provision is in force. A problem arises relating to scoping a record which encompasses a number of lower level records.

- 10 Consider as an example legislation marked up for point in time searching. The body of the legislation consists of *provisions* (or *nodes*), where each provision is an amendable unit of legislation. For the purposes of this example, each provision possesses the following four properties:

- 15
 - A single *parent*, or container provision in which the current provision resides.
[The *children* of a provision are those provisions which have the current provision as the parent.]
 - A *position* within a provision's parent, and (optionally) an associated *locator* (eg. the fourth child provision of an Act may have the locator "Chapter 2A").
 - A *scope* in time (i.e. start and end dates).
 - The *content* of the provision.

- 20 The provisions are divided into three classes:

- A single *root* node, which has no parent, but from which all other nodes ultimately descend;
- A set of *terminal* nodes, which have no children; and
- A set of *higher level* nodes which are neither the root node nor terminal.

The legislation can then be said to form a tree descending from the root node and containing the terminal nodes at the ends of the root node's branches.

The scope of a terminal node is the period of time between the terminal node's start date and end date, inclusive. The root node is deemed to be always in scope. The
5 scope of a node which is neither a terminal node nor a root node is problematic.

For example, a chapter may encompass many sections, but the chapter's actual content, viewed in isolation as a record, is simply the chapter's title, including locator if present, and any notes or other attachments that apply to the chapter as a whole. All other content is contained indirectly via the chapter's descendant provisions, such as parts,
10 sections and the like.

Difficulty arises in determining the scope of the chapter node. In one sense, the scope of the chapter node is the sum of the scopes of the chapter node's descendants. A question then arises if, for example, the chapter's title is altered. The same applies to the case in which the abovementioned notes or other attachments are altered.

15 One solution is to create a duplicate chapter with the altered title. While effective, this method has some major drawbacks. Firstly, it involves a great deal of unnecessary duplication of material. Since each child provision can have only one parent; new copies of every sub-level have to be made. The scope of both the original and duplicate sublevels then have to be split at the date of the chapter's title change. This in
20 turn requires each sub-level to behave as though amended, even though the amendment only applies to the title of an ancestor level.

A better solution is to create a new terminal sub-level of the chapter which contains just the title and associated text. This sub-level can then be scoped independently of the main level, and other sub-levels are unaffected. The sub-levels
25 retain the same parent as the chapter level itself was not affected by the amendment.

However, this still leaves open the question of what to do with the scope of the chapter level. Clearly a chapter, like any other provision, can be created or repealed. Thus, an amendment such as "repeal Chapter 2A" should end the scope of the chapter level as well as all of the chapter's descendants.

- 5 The editors, however, may wish to leave a *stub* entry to mark the place of the former chapter thus:

Chapter 2A

[repealed]

- 10 The scope of the stub clearly lies outside the scope of the chapter. There are three possible solutions:

- allow the [repealed] entry (which stands in place of a normal title) to live inside the chapter, even though the entry is out of the chapter's scope;
- extend the scope of the chapter to encompass the scope of the stub; or
- create a new chapter level containing just the stub.

- 15 The first option creates significant inefficiencies in the design, since the scope of a sub-level cannot be assumed to lie within the scope of the sub-level's parent. The other two options give rise to potential conflicts between the stub and possible replacement chapters.

- 20 Having delegated the title and other general notes to their own sublevels, all content has effectively been removed from the chapter. However, a chapter level is still required, as removing higher levels makes all terminal nodes direct children of the root. This in turn severely impacts on the usefulness of the data when mapped to a hierarchical form, such as XML.

- 25 In addition, a higher level does contain one property, namely one or more locators ("Chapter 2A" in the example). While this property can theoretically be

delegated to yet another sub-level, the practical implications are significant. In particular, the locator reflects the ordering of the chapter amongst its siblings. If, for example, an amendment renumbers chapter 2A to chapter 4, this gives rise to the issue of whether the chapter comes before or after chapter 3 in either a flat file or in XML. For this reason, the

5 locator is the sole property preserved by a higher level node throughout the higher level node's scope. If the position is changed, then a new level (and sub-levels) is created.

This still leaves the problem of the scope of a higher level. For example, if Chapter 2A is repealed and a new, unrelated chapter 2A immediately takes the place of the repealed Chapter 2A, a problem is potentially presented as to two overlapping scopes

10 for the same provision. The scope of the original node has to be terminated, otherwise there are two Chapter 2As in scope contemporaneously. The co-existence of two Chapter 2As poses a detrimental impact on the ability to navigate and search the legislation under consideration. In the situation in which the original Chapter 2A has a repeal stub, the original Chapter 2A's scope may overlap the new Chapter 2A, since the stub may

15 continue indefinitely in time. Among many possibilities, a repeal stub may be provided while Chapter 2A does not exist.

Other problems include: repeal or substitution of a higher level node; renumbering/relocation of a higher level node; renaming (without renumbering/relocation) of a higher level node; elevation or demotion of a higher level

20 node within the hierarchy, e.g. changing a part to a chapter or a division to a subdivision; and insertion/removal of an intermediate level heading node, requiring that nodes which follow and are/were, according to their type, inferior to that heading node become/ cease to be children of that node.

In order to resolve these problems, the following design rule is applied:

25

Higher level nodes may have neither scope nor content.

In other words, a non-terminal node must be a container only. A non-terminal node's only properties are a parent indicator, a position within the parent, and (optionally) a locator. Any content notionally belonging to such a node, such as a chapter title, is assigned to a new (terminal) child node. A (terminal) child node may contain a label,
5 which is preferably a title, but can be or include other data related to the parent node. The new child node preserves the scope of the title, so (for example) a single chapter may possess a number of (temporally disjoint) title nodes.

Higher level scoping has a number of surprising but useful consequences. In particular, a higher level provision is, in itself, not subject to amendment. Thus, an
10 instruction such as "Repeal Chapter 2A" actually terminates the scope of all of Chapter 2A's constituent terminal nodes. The chapter node, having no scope of its own, is unaffected.

Additionally, the previously described problem pertaining to the overlapping scope of the 2A repeal stub disappears. Embodiments of the invention utilise the
15 following approaches. When Chapter 2A is repealed, the associated scope of all terminal nodes within Chapter 2A is terminated. In a first embodiment, a new Chapter 2A is enacted immediately after the original chapter is terminated. The new Chapter 2A has an associated scope commencing on the day after which the original Chapter 2A was repealed. In a second embodiment, a repeal stub is introduced. A repeal stub in the
20 preferred embodiment is a title with an attribute marking this title as being of the type "repeal stub". The repeal stub has an associated scope with a start date corresponding to the date after which Chapter 2A was repealed. The repeal stub has the Chapter 2A node as a parent. If a new Chapter 2A is later enacted, the scope of the repeal stub is terminated and the scope of the terminal nodes of the new Chapter 2A will begin on the
25 day after the end date of the repeal stub's scope.

Thus, a request "for Chapter 2A on date X" returns a description of Chapter 2A that was valid on that date. In the event that the request is for a date on which the chapter is repealed, the fact that the chapter is not in force, having been repealed on or before that date, will be returned.

- 5 A portion of Document Type Definition (DTD) code which is used to enable higher level scoping appears in Tables 1 to 7 below:

Table 1

```
<!--
#####
ENTITY:      hlev-id
PURPOSE:      Concatenation of the elements that make the
Identification of a higher level element. Only to be used for levels in
which the <desc> can be MALTed - for levels in which the whole level
should be MALTed (ie, section, reg, schedule) and for their sub-levels,
use %lev-id;.
#####
-->
<ENTITY % hlev-id
      "(target*, label?, (desc, %amendments;)*)"
>
```

Table 2

```
<ELEMENT act
  (%hlev-id,
  (%hnote; | %raw;)*,
  (longtitle, %amendments;)+,
  preamble*,
  (chapter* | part* | section*),
  (schedule* | include+)*,
  hist* )
>
<ATTLIST act
  juris
    (cth|nsw|vic|qld|sa|wa|tas|act|nt|imp)
    #REQUIRED
  year
    CDATA
    #REQUIRED
  number
    CDATA
    #REQUIRED
>
```

Table 3

```
<ELEMENT regulations
  (%hlev-id,
```

```

        (%hnote; | %raw;)*,
        (chapter* | part* | reg*),
        (schedule* | include+)*
    )
>
<|ATTLIST regulations
    juris
        (cth|nsw|vic|qld|sa|wa|tas|act|nt|imp)
        #REQUIRED
    year
        CDATA
        #REQUIRED
    number
        CDATA
        #REQUIRED
>
<|ELEMENT chapter
    (%hlev-id;,
    (%hnote;)*,
    (((%secreg;)*, part*) | article+))
>
<|ATTLIST chapter
    id
        CDATA
        #IMPLIED
    next-id
        CDATA
        #IMPLIED
>

```

Table 4

```

<|ELEMENT part
    (%hlev-id;,
    hist*,
    (((%secreg;)*, division*) |
    (article+ | item+ | clause+) |
    (guide+) |
    (unconverted+)))
>
<|ATTLIST part
    id
        CDATA
        #IMPLIED
    next-id
        CDATA
        #IMPLIED
>

```

Table 5

```

<|ELEMENT division
    (%hlev-id;,
    (p | %hnote;)*,
    (((%secreg;)*, subdivn*) |
    (clause*, item*)))
>
<|ATTLIST division

```

```

      id
      CDATA
      #IMPLIED
    next-id
      CDATA
      #IMPLIED
  >

```

Table 6

```

<!ELEMENT subdivn
  (%hlev-id;
   (%hnote;)*,
   ((%secreg;)+ | clause+))
>
<!ATTLIST subdivn
  id
    CDATA
    #IMPLIED
  next-id
    CDATA
    #IMPLIED
>

```

Table 7

```

<!--
#####
ELEMENT:    desc
PURPOSE:    Defines the "description" of a level.

ATTRIBUTES:
  %date-atts; - defines the start and end dates for this version
               of the description.

#####
-->
<!ELEMENT desc
  (%PCDATA | %refs; | %effect; | quote)*
>
<!ATTLIST desc
  %date-atts;
>

```

The DTD has been altered such that scoping is transferred from the higher level nodes to terminal nodes.

Consider an example consisting of an Act with two chapters, the second chapter

5 containing two sections, as shown by the system 500 of Fig. 4. A root node 510 represents the Act. The root node 510 has no parent, and all other nodes descend from the

root node 510. The first chapter of the Act is represented by a higher level node 520. As a higher level node, node 520 has neither scope nor content. Node 520 has the following properties: a parent, being the Act node 510; a position within the parent node 510, being 1; and an optional locator, being "Chapter 1". Node 520 has two descendant nodes 522, 524. Node 522 has the following properties: a parent, being the node 520 identified by its locator "Chapter 1"; a position within the parent node 520, being 1; an optional locator, being "Chapter 1 Description"; scope, being 1 January 1998 onwards; and content relating to the title or textual description of the first chapter of the Act under consideration. Node 524 has the following properties: a parent, being the node 520 identified by its locator "Chapter 1"; a position within the parent node 520, being 2; an optional locator, being "Chapter 1 Note"; scope, being 1 January 1998 onwards; and content providing general notes or comments pertaining to the first chapter of the Act under consideration.

A second higher level node 530 represents the second chapter of the Act. Node 530 has two sections. Node 530 has the following properties: parent, being the Act node 510; a position within the parent node 510, being 2; and an optional locator, being "Chapter 2A". Node 530 has five child nodes: 532, 534, 536, 540 and 550, each of which is a terminal node in this example. Node 532 has the properties: parent, being Chapter 2A; a position within the parent, being 1; an optional locator, being "Chapter 2A description"; scope, being 1 January 1998 – 30 June 1998; and content, being "Company Registration". Node 534 has the properties: parent, being Chapter 2A; a position within the parent, being 2; an optional locator, being "Chapter 2A description"; scope, being 1 July 1998 onwards; and content, being "Registering a Company". Node 536 has the properties: parent, being Chapter 2A; a position within the parent, being 3; an optional locator, being "Chapter 2A note"; scope; and content. Node 540 has the properties: parent, being Chapter 2A; a

position within the parent, being 4; an optional locator, being "Section 11"; scope; and content. Node 550 has the properties: parent, being Chapter 2A; a position within the parent, being 5; an optional locator, being "Section 12"; scope; and content.

The different scopes of nodes 532 and 534 allow nodes 532, 534 to co-exist,
5 without overlapping. Nodes 532, 534 may share the same locator, but the combination of locator and scope uniquely identifies the nodes. Nodes 532, 534 reflect the amendment of the title of Chapter 2A from "Company Registration" to "Registering a Company". The scopes of nodes 532, 534 indicate that the amendment came into effect on 1 July 1998.

In accordance with a further embodiment, higher level scoping is extended to facilitate
10 commentaries, subject indices and similar material. When considering legislation, any amendment results in the production of a modified portion. However, when considering commentaries, two types of amendment to the commentary are possible. In the first scenario, corresponding to the legislation example, the scope of the current predefined portion of commentary is terminated and a new predefined portion is provided. The new
15 predefined portion has a scope commencing on the day after the expiration of the current predefined portion. In the second possible scenario, the current predefined portion of the commentary is amended without a second predefined portion being created.

The scope of commentary portions is extended to include three dates: a start date, an update date and an end date. Referring to Fig. 5A, a screen shot 560 shows a
20 commentary. The commentary was created on 1 July 2000, as seen from the amendment bar 565. The commentary has the following scope properties: start date of 1 July 2000, no update date and no end date. Fig. 5B shows a screen shot 570 of the commentary of Fig. 5A at a later date. The amendment bar 575 indicates that the commentary was last updated on 1 September 2000. Thus, the scope of the commentary now has a start date of
25 1 July 2000, an update date of 1 September 2000 and no end date. Fig. 5C shows a

further screen shot 580 of the commentary of Fig. 5A and 5B at a yet later date. The amendment bar 584 indicates that at least one further amendment has been applied to the commentary since the update of 1 September 2000 indicated at 575 in Fig. 5B. The amendment bar 585 of Fig. 5C shows that the last update date of the commentary is 1
5 October 2000. Therefore, the scope properties of the commentary now read: First portion: start date of 1 July 2000, end date of 30 September 2000; Second portion: start date of 1 October 2000, and no end date.

In a further embodiment, XML data may be divided into predefined portions and stored as a collection of flat files. In an example, the flat files take the form of a relational
10 database. There is a one to one correspondence between the XML data and the relational database. The hierarchy of the XML data is expressed via the implementation of higher level scoping. A single record is provided with an identifier and other terminal nodes are provided in which to store the remainder of the information.

The process for navigating in a multidimensional space containing an electronic
15 publication formed from predefined portions of text-based data encoded using a markup language can be implemented using a computer program product in conjunction with a computer system 600 as shown in Fig. 6. In particular, the process for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language can be implemented as
20 software, or computer readable program code, executing on the computer system 600.

Similarly, the process for publishing an electronic publication formed from predefined portions of text-based data encoded using a markup language may also be implemented using a computer program product in conjunction with the computer system 600 shown in Fig. 6.

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The computer system 600 includes a computer 650, a video display 610, and input devices 630, 632. In addition, the computer system 600 can have any of a number of other output devices including line printers, laser printers, plotters, and other reproduction devices connected to the computer 650. The computer system 600 can be connected to one or more other computers via a communication input/output (I/O) interface 664 using an appropriate communication channel 640 such as a modem communications path, an electronic network, or the like. The network may include a local area network (LAN), a wide area network (WAN), an Intranet, and/or the Internet 620.

The computer 650 includes the control module 668, a memory 670 that may include random access memory (RAM) and read-only memory (ROM), input/output (I/O) interfaces 664, 672, a video interface 660, and one or more storage devices generally represented by the storage device 662. The control module 668 is implemented using a central processing unit (CPU) that executes or runs a computer readable program code that performs a particular function or related set of functions.

The video interface 660 is connected to the video display 610 and provides video signals from the computer 650 for display on the video display 610. User input to operate the computer 650 can be provided by one or more of the input devices 630, 632 via the I/O interface 672. For example, a user of the computer 650 can use a keyboard as I/O interface 630 and/or a pointing device such as a mouse as I/O interface 632. The keyboard and the mouse provide input to the computer 650. The storage device 662 can consist of one or more of the following: a floppy disk, a hard disk drive, a magneto-optical disk drive, CD-ROM, magnetic tape or any other of a number of non-volatile storage devices well known to those skilled in the art. Each of the elements in the computer system 650 is typically connected to other devices via a bus 680 that in turn can consist of data, address, and control buses.

The method steps for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language are effected by instructions in the software that are carried out by the computer system 600. Again, the software may be implemented as one or more modules

5 for implementing the method steps.

In particular, the software may be stored in a computer readable medium, including the storage device 662 or that is downloaded from a remote location via the interface 664 and communications channel 640 from the Internet 620 or another network location or site. The computer system 600 includes the computer readable medium having such

10 software or program code recorded such that instructions of the software or the program code can be carried out. The use of the computer system 600 preferably effects advantageous apparatuses for navigating a multidimensional space containing an electronic publication formed from predefined portions of text based data encoded using a markup language and for publishing an electronic publication formed from predefined

15 portions of text based data encoded using a markup language in accordance with the embodiments of the invention.

The computer system 600 is provided for illustrative purposes and other configurations can be employed without departing from the scope and spirit of the invention. The foregoing is merely an example of the types of computers or computer

20 systems with which the embodiments of the invention may be practised. Typically, the processes of the embodiments are resident as software or a computer readable program code recorded on a hard disk drive as the computer readable medium, and read and controlled using the control module 668. Intermediate storage of the program code and any data including entities, tickets, and the like may be accomplished using the memory

25 670, possibly in concert with the storage device 662.

In some instances, the program may be supplied to the user encoded on a CD-ROM or a floppy disk (both generally depicted by the storage device 662), or alternatively could be read by the user from the network via a modem device connected to the computer 650. Still further, the computer system 600 can load the software from other computer readable media. This may include magnetic tape, a ROM or integrated circuit, a magneto-optical disk, a radio or infra-red transmission channel between the computer and another device, a computer readable card such as a PC card, and the Internet 620 and Intranets including email transmissions and information recorded on Internet sites and the like. The foregoing are merely examples of relevant computer readable media. Other computer readable media may be practised without departing from the scope and spirit of the invention.

The process for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language can be realised in a centralised fashion in one computer system 600, or in a distributed fashion where different elements are spread across several interconnected computer systems.

The process for publishing an electronic publication formed from predefined portions of text-based data encoded using a markup language may also be implemented using a computer program product in conjunction with the computer system 600 of Fig. 6 in a manner similar to that which has just been described.

Computer program modules or computer program in the present context mean any expression, in any language, code or notation, of a set of instructions intended to cause a system having an information processing capability to perform a particular function either directly or after either or both of the following: a) conversion to another language, code or notation or b) reproduction in a different material form.

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In the foregoing manner, a method, an apparatus, and a computer program product for navigating in a multidimensional space containing an electronic publication formed from predefined portions of text-based data encoded using a markup language are disclosed. Further, a method, an apparatus, and a computer program product for
5 publishing an electronic publication formed from predefined portions of text-based data encoded using a markup language are disclosed. While only a small number of embodiments are described, it will be apparent to those skilled in the art in view of this disclosure that numerous changes and/or modifications can be made without departing from the scope and spirit of the invention.

10

Industrial Applicability

It is apparent from the above that the arrangements described are applicable to the electronic publishing industry.

The foregoing describes only some embodiments of the present invention, and
15 modifications and/or changes can be made thereto without departing from the scope and spirit of the invention, the embodiments being illustrative and not restrictive.